AMENDMENTS TO THE SPECIFICATION

Please replace paragraphs [0009], [0026], [0028], [0029], [0032], [0034], [0035], [0037], [0038], [0039], [0043], [0044], [0050], and [0052] with the following respective paragraphs:

[0009] Embodiments of the invention may further provide a plating solution mixing and delivery system for an electrochemical plating platform. The plating solution mixing and delivery system includes a fluid mixing apparatus, having a fluid metering pump having a plurality inputs and at least one output, a base solution container in fluid communication with one of the plurality of inputs, a plurality of additive containers, each of the plurality of additive containers being in fluid communication with at least one of the inputs, and a controller in communication with the fluid metering pump, the controller being configured to operate the metering pump such that the base solution and fluid from the plurality of additive containers is mixed in a predetermined ratio and dispensed from one of the at least one outputs. The system further includes a fluid dispensing manifold in fluid communication with the fluid mixing apparatus, [[a]] an anolyte conduit in fluid communication with the manifold, a catholyte conduit in fluid communication with the mixing manifold, at least one anolyte tank in fluid communication with the first conduit, and at least one catholyte tank in fluid communication with the second conduit.

[0026] Figure 3 is a schematic diagram of one embodiment of a plating solution delivery system ~~111~~ <u>300</u>. The plating solution delivery system ~~111~~ <u>300</u> is generally configured to supply a plating solution or anolyte solution to each processing location on system 100 that requires one of these solutions. More particularly, the plating solution delivery system is further configured to supply a different plating solution or chemistry to each of the processing locations. For example, the delivery system may provide a first plating solution or chemistry to processing locations 110, 112, while providing a different plating solution or chemistry to processing locations 102, 104. The individual plating solutions are generally isolated for use with a single plating cell, and therefore, there are no cross contamination issues with the different chemistries. However, embodiments of

the invention contemplate that more than one cell may share a common chemistry that is different from another chemistry that is supplied to another plating cell on the system. These features are advantageous, as the ability to provide multiple chemistries to a single processing platform allows for multiple chemistry plating processes on a single platform.

[0028] Plating solution delivery system ~~111~~ 300 typically includes a plurality of additive sources 302 and at least one electrolyte source 304 that are fluidly coupled to each of the processing cells of system 100 via a manifold 332. Typically, the additive sources 302 include an accelerator source 306, a leveler source 308, and a suppressor source 310. The accelerator source 306 is adapted to provide an accelerator material that typically adsorbs on the surface of the substrate and locally accelerates the electrical current at a given voltage where they adsorb. Examples of accelerators include sulfide-based molecules. The leveler source 308 is adapted to provide a leveler material that operates to facilitate planar plating. Examples of levelers are nitrogen containing long chain polymers. The suppressor source 310 is adapted to provide suppressor materials that tend to reduce electrical current at the sites where they adsorb (typically the upper edges/corners of high aspect ratio features). Therefore, suppressors slow the plating process at those locations, thereby reducing premature closure of the feature before the feature is completely filled and minimizing detrimental void formation. Examples of suppressors include polymers of polyethylene glycol, mixtures of ethylene oxides and propylene oxides, or copolymers of ethylene oxides and propylene oxides.

[0029] In order to prevent situations where an additive source runs out and to minimize additive waste during bulk container replacement, each of the additive sources 302 generally includes a bulk or larger storage container 306A, 308A, 310A coupled to a smaller buffer container ~~316~~ 306B, 308B, 310B. The buffer container ~~316~~ 306B, 308B, 310B is generally filled from the bulk storage container ~~314~~ 306A, 308A, 310A, and therefore, the bulk container 306A, 308A, 310A may be removed for replacement without affecting the operation of the fluid delivery system, as the associated buffer container 306B, 308B, 310B may supply the particular additive to the system while the bulk container

306B, 308B, 310B is being replaced. The volume of the buffer container ~~316~~ 306B, 308B, 310B is typically much less than the volume of the bulk container ~~314~~ 306A, 308A, 310A. It is sized to contain enough additive for 10 to 12 hours of uninterrupted operation. This provides sufficient time for operators to replace the bulk container 306A, 308A, 310A when the bulk container 306A, 308A, 310A is empty. If the buffer container 306B, 308B, 310B was not present and uninterrupted operation was still desired, the bulk containers 306A, 308A, 310A would have to be replaced prior to being empty, thus resulting in significant additive waste.

[0032] In order to implement the fluid delivery system capable of providing two separate chemistries from separate base electrolytes, a duplicate of the fluid delivery system illustrated in Figure 3 is connected to the processing system. More particularly, the fluid delivery system illustrated in Figure 3 is generally modified to include a second set of additive containers 302, a second pump assembly ~~330~~ 312, and a second manifold 332 (shared manifolds are possible). Additionally, separate sources for virgin makeup solution/ base electrolyte 304 are also provided. The additional hardware is set up in the same configuration as the hardware illustrated in Figure 3, however, the second fluid delivery system is generally in parallel with the illustrated or first fluid delivery system. Thus, with this configuration implemented, either base chemistry with any combination of the available additives may be provided to any one or more of the processing cells of system 100.

[0034] In some embodiments, it may be desirable to purge the dosing pump 312, output line 340 and/or manifold 332. To facilitate such purging, the plating solution delivery system ~~111~~ 300 is configured to supply at least one of a cleaning and/or purging fluid, which may be deionized water or a purge gas, for example. In the embodiment depicted in Figure 3, the plating solution delivery system ~~111~~ 300 includes a deionized water source 342 and a non-reactive gas source 344 coupled to the first delivery line 350. The non-reactive gas source 344 may supply a non-reactive gas, such as an inert gas, air, or nitrogen through the first delivery line 350 to flush out the manifold 332. Deionized water may be provided from the deionized water source 342 to flush out the manifold 332 in

addition to, or in place of the non-reactive gas. Electrolyte from the electrolyte sources 304 may also be utilized as a purge medium.

[0035] A second delivery line 352 is teed between the first ~~gas~~ delivery line 350 and the dosing pump 312. A purge fluid includes at least one of the electrolyte, deionized water or non-reactive gas from their respective sources 304, 342, 344 may be diverted from the first delivery line 350 through the second ~~gas~~ delivery line 352 to the dosing pump 312. The purge fluid is driven through the dosing pump 312 and out the output line 340 to the manifold 332. The valve bank 334 typically directs the purge fluid out a drain port 338 to the reclamation system 232. The various other valves, regulators and other flow control devices ~~for~~ have not been described and/or shown for the sake of brevity.

[0037] Plating solution delivery system ~~110~~ 300 is in communication with a plurality of fluid conduits that connect the fluid delivery system 110 to fluid storage tanks positioned on board plating system 100. More particularly, the fluid dispensing manifold 332 is generally in communication with a plurality of conduits 401, 402, 403, as illustrated in Figure 4. Each of the conduits 401, 402, 403 connects to a particular fluid storage tank[[s]] 404-411, which will be further discussed herein. As such, the fluid delivery system ~~110~~ 300 may be controlled to mix and provide a particular catholyte or anolyte solution to any one of the tanks 404-411. The particular anolyte/catholyte solution is provided to manifold 332, which selectively opens actuatable valves to allow the particular solution to flow into one of conduits 401, 402, 403. Assuming, for example, that conduit 401 is configured to supply a particular catholyte to a specific plating cell on platform 100, then the catholyte supplied to conduit 401 is carried by the conduit to a particular plating cell holding tank, such as tank 404, that is configured to supply the specified plating cell with a catholyte. The catholyte solution is delivered to tank 404 and then a valve 412, positioned in conduit 401 immediate tank 404, closes and terminates the flow of solution into tank 404. Then the tank 404 may be used to supply catholyte to a particular plating cell on platform 100 for an electrochemical plating process.

[0038] The solution remaining the conduit 401 after supplying solution to the tank 404 may be purged or drained from the conduit prior to another solution being supplied to one or more cells through the particular conduit, so that cross contamination issues may be minimized. The section of the conduit between the valve 412 and the tank 404 is generally configured to purge into the tank, *i.e.*, the conduit may be shaped and sized such that once the solution flow is terminated, the fluid remaining in the conduit is urged to flow into the tank, thus emptying the conduit. The remaining portion of the conduit, *e.g.*, the portion of the conduit behind the valve, is purged through application of a purge gas or liquid to the line. Additionally, as noted above with respect to purging of the mixing manifold, the purge liquid may be the VMS solution.

[0039] Each of the tanks illustrated in Figure 4, *i.e.*, tanks 404-411, are generally arranged in pairs. More particularly, tanks 404 and 405 operate as a pair, while tanks 406 and 407, tanks 408 and 409, and tanks 410 and 411 similarly operate as tank pairs. The tank pair generally includes a first tank configured to contain a first solution and a second tank configured to contain a second solution that is different from the first solution. In the exemplary plating system illustrated in Figure 1, plating location 112 may be outfitted with a plating cell, such as plating cell 200 illustrated in Figure 2.~~, and therefore, and first~~ The first tank ~~400~~ 404 may be configured to supply a catholyte solution to cell 200, while the second tank 405 may be configured to provide an anolyte solution to plating cell 200. As noted above, the catholyte solution may be prepared by fluid delivery system ~~110~~ 300 and delivered to tank 404 via conduit 401. Similarly, the anolyte solution may be prepared by fluid delivery system ~~110~~ 300 and provided to anolyte tank 405 via conduit 403. The respective conduits may be purged after supplying the respective solution to the tanks so that different solutions may be supplied to different tank pairs without contamination.

[0043] In addition to the interior walls 508, selected compartments of the tanks may include angled fluid diversion walls 605, 606, and 607 positioned therein, as illustrated in Figure [[7]] 6A. More particularly, the fluid tanks may include a slanted or angled fluid receiving wall 700 as illustrated in Figure 7. The angled or slanted wall 700 may be an

exterior wall or an interior wall. Regardless, the slanted wall is configured to minimize bubble formation in the solution contained in the tank via minimization of bubbles generated by pouring the liquid solution vertically into the tank. In this embodiment the fluid delivered to the tank is dispensed onto the angled wall 700 by the fluid return line 502, such that the fluid flows onto the wall 700 at location 701 and flows downwardly along the surface of the wall 700 in the direction indicated by arrow "A" into the solution contained in the tank. The flow of the solution down the sloped or slanted wall into the solution minimizes bubbles formed at the interface between solution in the tank and the solution being returned to the tank.

[0044] Therefore, in operation, fluid is generally returned to tank 500 via a fluid supply line 610 that terminates in a first fluid compartment 601 (optionally the fluid supply line may terminate onto an angled wall, as described above). The fluid supplied to compartments 601 travels through a first fluid pass-through 611 into a second fluid compartment 602. Once the fluid enters the second fluid compartment 602, the fluid is directed toward an angled fluid diversion wall 605. The fluid travels around the angled fluid diversion wall 605 and travels through a second fluid pass-through 612 into a second fluid compartment 608. In similar fashion to the first fluid compartment, the fluid closed against an angled wall and through another fluid pass-through into a third fluid compartment 603, where the same process is repeated until the fluid passes through a final fluid pass-through 614 into a final fluid compartment 604. Each of the individual angled walls are configured to interact with the fluid flow in a manner that minimizes bubbles in the tank, as will be further discussed herein. Further, the positioning of the pass throughs 611-614 also operates to minimize bubbles in the tanks, as the buoyancy of the bubbles generally prevents the bubbles from traveling through the pass throughs positioned in the lower portion of the respective walls. The pump head ~~500~~ 504 generally terminates in the final fluid compartment 604, and therefore, fluid is pumped from tank 500 via [[a]] the pump head 504 out of the final compartment 604.

[0050] When operating an electrochemical plating platform, such as platform 100 illustrated in Figure 1, ~~for~~ the delivery system ~~110~~ 300 may be activated to generate a catholyte solution for plating cells positioned at processing locations 112 and 110. The catholyte solution may contain an appropriate amount of acid, halides, supporting electrolyte, additives, and/or other components generally used in electrochemical plating solutions. The solution may be mixed in fluid delivery system ~~110~~ 300, pumped via conduit ~~342~~ 350 to manifold 332, and supplied to conduit 401 for delivery to tanks 404 and 406. In this configuration, tanks 404 and 406 are in the fluid communication with a catholyte chamber of plating cell 200 positioned at processing locations 110 and 112. Since plating cell 200 is the type of plating cell requiring both a catholyte and an anolyte, fluid delivery system ~~110~~ 300 may also be activated to generate in anolyte for use in the cells. The anolyte may be generated in fluid delivery system ~~110~~ 300, transmitted to manifold 332, and delivered to tanks 405 and 407 via fluid conduit 403. Tanks 405 and 407 are generally in fluid communication with an anode or anolyte compartment of plating cell 200 positioned at processing locations 110 and 112.

[0052] Similarly, once the bottom up or feature fill process is completed, substrates are generally put through a secondary plating process wherein the features are bulk filled or overfilled. The bulk filling process is generally conducted at a greater plating rate than the feature fill process, and therefore, generally uses an increased current density. As such, the chemistry used to promote feature fill may not be optimal for promoting bulk fill processes. Therefore, the plumbing system of the invention provides for additional chemistry capability, such that the feature fill processes and the bulk fill processes may be both conducted on the same platform, even though different chemistries are required to optimize each process. More particularly, processing locations 102 and ~~100~~ 104 ~~for~~ may include plating cells 200 positioned thereon, wherein the plating cells are configured to promote pulp fill plating processes. Although the plating cell used for feature fill may be essentially identical to the plating cell used for bulk fill, the chemistries supplied to the respective cells is generally different. Thus, the plumbing system of the present invention may be configured to provide a separate catholyte and/or anolyte to tanks ~~418-411~~ 408-

411, which are generally configured to supply these respective solutions to processing locations 102, 104. Specifically, fluid delivery system 110 may be activated and caused to generate a catholyte solution configured to promote pulp fill plating processes. The catholyte solution may be delivered to manifold 332, which supplies the catholyte solution to fluid conduit 402. Fluid conduit 402 may deliver the bulk fill catholyte solution to tanks 409 and 411. Similarly, fluid delivery system ~~110~~ 300 may be used to generate an anolyte solutions for the bulk fill process, and this anolyte solution may ~~need~~ be delivered to tanks 408 and 410 via conduit 403.